

Engineering Identity as a Predictor of Undergraduate Students' Persistence in Engineering

Dr. Debra A Major Major, Old Dominion University

Debra A. Major, Professor & Eminent Scholar at Old Dominion University (ODU), earned her Ph.D. in Industrial/Organizational Psychology from Michigan State University. Her research focuses on broadening participation in STEM. She is particularly interested in barriers encountered by women and ethnic minorities in college and in the workforce. Her work has received continuous funding from the National Science Foundation for over 15 years, and she has led numerous multidisciplinary and multi-institutional research teams. Dr. Major is fellow of the American Psychological Association, the Association for Psychological Science, and the Society for Industrial and Organizational Psychology and the Society for the Psychology of Women. She is presently serving as Associate Dean in the College of Sciences at ODU.

Seterra D. Burluson, Old Dominion University

Seterra is a doctoral student at Old Dominion University. She works as a graduate research assistant and conducts research with Dr. Debra A. Major to identify barriers, such as work-family conflict, for women and minority populations in STEM and ways to keep people motivated to continue pursuing a STEM profession. In 2013, she graduated from the University of Montana with a degree in psychology and is currently pursuing her Ph.D. in industrial-organizational psychology.

Xiaoxiao Hu, Old Dominion University

Xiaoxiao Hu is an Associate Professor in the Psychology Department at Old Dominion University. She received her PhD in Industrial/Organizational psychology from George Mason University. She is a member of the American Psychological Association, the Society for Industrial and Organizational Psychology, the Academy of Management, and the International Association for Chinese Management Research. She served as the chair of the Psychology Section for Virginia Academy of Science in 2013. Her primary research areas are on affective experience and relational dynamics in the workplace. She also does research on psychometric and measurement issues as well as cross-cultural comparisons between the East and the West. Her work has appeared in journals including *Journal of Organizational Behavior*, *Journal of Vocational Behavior*, and *Journal of Managerial Psychology*. She currently serves on the editorial board of *Journal of Business and Psychology*.

Dr. Kristi J. Shryock, Texas A&M University

Dr. Kristi J. Shryock is the Frank and Jean Raymond Foundation Inc. Endowed Instructional Associate Professor and Associate Department Head in the Department of Aerospace Engineering in the College of Engineering at Texas A&M University. She also serves as Director of the Craig and Galen Brown Engineering Honors Program. She received her BS, MS, and PhD from the College of Engineering at Texas A&M. Kristi works to improve the undergraduate engineering experience through evaluating preparation in areas, such as mathematics and physics, evaluating engineering identity and its impact on retention, incorporating non-traditional teaching methods into the classroom, and engaging her students with interactive methods.

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Background and Objective

Improving the persistence of students in engineering disciplines through to graduation has become a pivotal strategy in national initiatives to increase the overall number of engineering graduates [1]. Prior research indicates that most undergraduate students who enter into an engineering major in the United States will not ultimately obtain a degree in engineering [2]. It has been suggested that many do not persist in engineering through to graduation due to a lack of ability, motivation, or interest, but there is evidence to suggest that other factors offer superior explanations for why individuals leave engineering [3]. Engineering identity, the degree to which engineering is central to a student's self-concept, has been found to explain retention-related outcomes better than a lack of interest or ability, and identity frameworks have, therefore, been utilized to further the understanding of persistence in engineering [4], [5], [6], [7]. The goal of this paper is to examine the relationship between the engineering identity of undergraduate students and later persistence in an engineering major in order to further understand the importance of engineering identity in influencing students' persistence in engineering. This will better inform future strategies aimed at improving engineering retention rates.

Research Design

Participants and Procedure

The measure of engineering identity was administered to a large sample of engineering students in the first year of their studies at a southwestern engineering school. Engineering identity was assessed at two time points, first prior to the start of fall semester before taking any engineering courses (Time 1). They were surveyed again at the close of fall semester, their first semester in the engineering program (Time 2). Students were provided time during summer orientation as well as class time to complete each survey. In total, 2315 participants completed the engineering identity measure at Time 1 ($n = 1,900$) and Time 2 ($n = 1083$). To assess students' persistence in engineering, retention information was obtained at the beginning of their second year, and this information reflected their major status at the end of the previous academic year (Time 3).

Measures

A five-item measure of engineering identity utilized in this study was developed and validated as a part of a larger National Science Foundation (NSF) Improving Undergraduate STEM Education (IUSE) project [8]. The measure has been supported to have a single-factor structure, supported through an EFA and three CFAs conducted with data at three time points. Convergent validity has been demonstrated through significant, positive correlations between the measure of engineering identity and the three dimensions of embeddedness, a conceptually related construct. Discriminant validity was supported through non-significant correlations between student

engineering identity and SAT scores. Lastly, predictive validity was supported in that engineering identity was found to relate to major satisfaction one semester later. Survey items are displayed in Appendix A.

Results

Results showed that there was a positive relationship between engineering identity at Time 1 ($M = 3.80$, $SD = .64$) and persistence in an engineering major at Time 3 ($r = .09$, $p < .001$, $n = 1,888$). A positive relationship was also observed between engineering identity at Time 2 ($M = 3.65$, $SD = .69$) and persistence in an engineering major at Time 3 ($r = .22$, $p < .001$, $n = 1,082$).

Conclusion

The current findings underscore the importance of considering engineering identity in efforts to explain undergraduate persistence in engineering and the potential utility of a brief quantitative measure of engineering identity in developing programs to improve engineering retention. Engineering identity during the first semester in an engineering program was more strongly related to persistence in engineering than engineering identity measured prior to the start of fall semester. This may be due to students' increasing understanding of what engineering entails and what it means to be an engineer as they are exposed to engineering coursework, faculty, and fellow students. Considering the observed relationship between engineering identity early on in students' engineering studies and persistence in engineering, future interventions might employ efforts to increase students' levels of identification with engineering along with other strategies to improve engineering retention. The findings suggest that the availability of a concise, validated measure of engineering identity will be valuable, as it will allow for the quick assessment of student engineering identity and promote understanding of the relationship between student engineering identity and persistence in engineering. The brief quantitative measure of engineering identity used in this study has the potential to be utilized in programs and interventions developed to improve retention rates in engineering programs, especially in those with larger numbers of participants. The findings presented are part of a larger project supported by the NSF under Grant No. 1504741.

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Appendix A

Survey Items

Engineering Identity

1. Engineering is an important part of who I am.
 2. I feel a personal attachment to engineering.
 3. Engineering has a great deal of personal meaning for me.
 4. I see engineering as a significant part of my life.
 5. I spend a lot of time in casual conversations about engineering.
- **Note.* Response scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*).